



International Journal of Innovative Research in Science Engineering and Technology (IJIRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 8.699

Volume 14, Issue 3, March 2025

Impact of Salt Water on Water Absorption and Strength Characteristics of Fly Ash and Clay Bricks

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ABSTRACT: The ability of bricks to absorb water greatly affects the durability and structural performance of bricks being used within construction. This study investigates the water absorption characteristics of fly ash bricks and clay bricks under different environmental conditions. Water absorption tests were carried out on six brick samples (three fly ash bricks and three clay bricks); tests were carried out by immersing the different types of bricks in different water types: fresh water, salt water, and acidic water. The results show that clay bricks absorb much more water than fly ash bricks, making them weak and prone to deterioration with time. It was also noticed that saltwater further increases water absorption, adding to the risks in coastal and saline environments. Acidic conditions further increase the porosity of a brick structure and accelerate its degradation. Consequently, the current study comes out with the following: Fly ash bricks offered more resistance to water penetration than clay bricks, thus making fly ash bricks more applicable in areas of high moisture exposure. The study emphasises the selection of appropriate types of bricks based on end-use conditions that would enhance the performance of construction materials.

KEYWORDS: Fly ash brick, Clay brick, compressive strength, water absorption, salt water.

I. INTRODUCTION

Bricks, the very foundation of construction, have been used to a great extent in a number of residential, commercial, and infrastructure projects. Their measurement and strength way much in the determination of the shadow life of buildings and their stability. Of many, one most important physical property of bricks is concerned with water absorption in their performance under different environments. Water absorption influences the strength and durability of bricks and their resistance to environmental factors such as rain, humidity, and chemical attack. With high uptake of moisture on bricks, cracking, efflorescence, and later structural failure become the threat to such. Nowadays the two most widely used types of brick are clay brick and fly ash brick (Varma & Gadling, 2022). Clay bricks are formed from natural soil and are fired in kilns, while fly ash bricks are usually made, in varying proportions, of one or more industrial by-products, including fly ash, combined with relatively small amounts of cement, sand, and water, which makes them an eco-friendlier option (Hashmi, et al. 2022). But each brick has different water absorption characteristics that depend on its nature and mode of manufacture.

The turning point of this study is to compare the amount of water absorbed by fly ash bricks and clay bricks under various climatic conditions like, for example, normal water, seawater, and acidic water. This understanding of the kind of differences will help in selecting the right class of bricks for different climatic situations sensitive particularly to wet conditions such as coastal and very polluted industrialized areas. According to past researches, fly ash bricks have, in general, less porosity with high density; hence, they're much more resistant to the intrusion of water. On the other hand, due to their natural composition, clay bricks have the natural tendency to absorb much more moisture and hence are subject to accelerated deterioration in humid areas. Standard water absorption tests will be carried out for this research according to IS 3495 (Part 2) to pursue a comparative analysis of how different types of water affect the absorption behaviour of these bricks. The study will be beneficial for construction engineers, architects, and policy makers in selecting bricks for sustainable and durable structures. The increasing demand for ecofriendly and lasting construction materials is calling for greater attention to the use of fly ash bricks, particularly in places where water retention in

materials may weaken the building structures. The study not only points out the differentiated absorption of the two types of bricks but also examines their suitability for different climatic conditions. It is foreseen that the study would further the argument of promoting sustainable construction practices that assure the safety and durability of built structures under variable moisture contents.

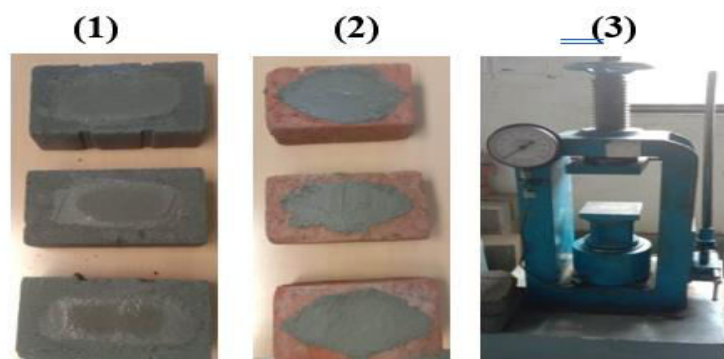
II. LITERATURE REVIEW

After several centuries of use as a reliable construction material, traditional clay bricks have started making an enormous impact on more than one planet (Clay Brick Waste, 2024). Fertile soil is being depleted as a result of this, enormous heat is needed for firing such bricks, and greenhouse gases are being emitted into the atmosphere. One important property of the clay brick is water absorption, affecting how long they last, plus resistance to freeze-thaw cycles (Khalaf & DeVenny, 2002). Several factors contribute toward determining the water absorption rates of these clay bricks: the clay composition, firing temperature, and environmental conditions. Fly ash bricks, for instance, are beginning to be considered as a green alternative, wherein fly ash is the byproduct obtained from combustion of coal (Rahman et al., 2021). The advantage of using them includes waste usage, savings in energy, and lower CO₂ emission (Al-Fakih et al., 2018; Rao, 2019). The water absorption characteristics exhibited by the fly ash bricks depend on the fly ash content, the processing of production, and what supplementary materials are added. Some studies suggest that fly ash bricks may exhibit less water absorption when compared with their clay brick counterparts, probably due to fine particles being able to fill in the pores that are present (Kusaimi et al., 2020). Studies that have applied comparison techniques have evaluated some differences with respect to water absorption that exists between fly ash and clay bricks; the differences pertain to their composition, manufacturing methods, and exposure conditions sustained therein (Wahab et al., 2021). However, understanding these differences among materials is crucial when determining which building materials are good for use under various climatic conditions. Further, water absorption of both types of bricks can be reduced by employing mitigation strategies that use additive or surface treatment methods, which shall enhance durability.

III. MATERIALS AND METHODOLOGY

The methodology follows standards of testing laid down in IS 3495:1992. In this context, The study used two types of bricks: clay bricks (225 mm x 105 mm x 75 mm) and fly ash bricks (230 mm x 110 mm x 100 mm). The study used ordinary Portland cement (OPC) as a binding material in a ratio of 1 part cement with 3 parts of sand. Sand of 4.75 mm IS sieve is used, while cement is passed through a 90-micron IS sieve to achieve uniform distribution of particle size for a constant material composition. The mortar is prepared with fresh water, whereas salt water prepared by dissolving 240g NaCl in 40kg of fresh water was used for curing the bricks and analysing its effects on water absorption and durability. To determine the impacts of saltwater on brick properties, the bricks were kept in salt water for 24 hours before testing was conducted. Observations regarding water absorption and compressive strength were made for clay and fly ash bricks. The investigation observes the effect of salt water exposure on the durability and strength of these bricks to inform building material selections for various environmental conditions.

Figure: (1) Fly Ash Bricks (2) Clay Bricks and (3) Compression Testing Machine



IV. RESULT AND DISCUSSION

The results of this study showed that the patterns for water absorption and compressive strength of both clay and fly ash bricks when treated with salt water are highly irregular. In the water absorption test, clay bricks absorb more water than fly ash bricks because of their porous and highly permeable nature. Fly ash bricks, on the other hand, contain finer particles and have a denser structure; hence they twist and absorb less water. They therefore represent a better solution for moisture-induced problems of deterioration. Supported with this assertion is that the salt water had an exponential effect on all bricks, while after immersion in saltwater, the compressive strength tests demonstrated reductions in compressive strength for both types. The drop in strength was evidently much more pronounced in clay than in fly ash. This screams loudly that long exposure to saline environments will degrade the durability and structural stability of clay bricks more than that of fly ash bricks.

This study, therefore, underlines the relevance of properly selecting the building materials based on the environmental conditions for assuring long-term stability. The effect of the salt waters absorption on the weight of the brick might also have some bearing on building load calculations. Because saltwater absorption increases the weight of bricks, this would tend to add stresses on the entire structure. The relevance of this is pronounced in the areas that are coastal and saline-rich because they would tend to be more affected by exposure to saltwater. The findings further indicate the need to pursue mitigation strategies such as surface treatments or protective coatings geared toward lessening the bad effects of saltwater on bricks.

V. CONCLUSION AND RECOMMENDATIONS

The current study identifies that salt water extensively impacts the physical and mechanical properties of both clay and fly ash bricks which are examined. Since clay bricks absorb more water, which implies their sensitivity to the impact of moisture, they shall not be recommended for construction in saline regions. Fly ash bricks appeared to be better in this aspect since they promise lesser water absorption and thus perform better under such conditions. The compressive strength test results reveal that both types of bricks are weakened by salt water exposure, but a more marked drop in strength occurs with clay bricks. Thus, they pass more severely in their utility tests according to which particular conditions they face: fly ash bricks are a better choice when constructions are going to face the salt water directly or indirectly. This study provides information on the behaviours of clay bricks and fly ash bricks when exposed to saline conditions. Further studies can be done on how to further improve the durability of those brick types through the use of additives or allowing alternative curing methods. There are other options for carrying out studies involving real-world buildings made with these materials, which will shed more light on the durability of these materials under a variety of changing conditions.

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